APPENDIX VII

A STUDY OF POSSIBLE METEOROLOGICAL INFLUENCES ON POLYNYA SIZE

by

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INTRODUCTION:

A polynya is rigorously defined as an irregularly shaped opening enclosed by ice which may contain brash ice or uniform ice of markedly thinner ice than the surrounding ice(Stringer, Barnett, and Godin, 1984). Polynyi are frequently described in the literature as non-linear open water areas surrounded by sea ice without mention of whether an attempt was made to clearly differentiate the open water from thin ice or if such a distinction was possible.

Polynyi are important for the understanding of climatic, oceanographic, and biological phenomena in the Arctic.

(1) The open water of the polynyi are important habitat for migratory water fowl and mammals(Stirling and Cleater, 1981).

(2) Their formation can be part of the pattern of break-up and melt-back of the ice edge (Stringer and Groves, 1985).

(3) Polynyi formation may affect the salt balance of the seawater in that they canbe viewed as conveyor belt-like generators of sea ice, a process which raises the salinity of water contained within the polynya(McNutt, 1981; Schumacher, Aagaard, Pease, and Tripp, 1983).

(4) Their location and the time of their

presence can be important for shipping and

other offshore economic activity.

Dey, Moore, and Gregory(1979)describe the use of NOAA thermal
infrared imagery for monitoring and mapping sea ice freeze-up and
break-up and a method of rectifying NOAA images. Dey(1980)describes
the use of thermal infrared images for monitoring North Water, a
polynya located in Northern Baffin Bay for the months of
November-Janua ry. They concluded NOAA thermal infrared images are
admirably suited for generalized statistical analysis-of sea ice and
that boundaries between first- and multiyear ice and open water can be
mapped more reliably than boundaries between open water and thin ice.

Smith and Rigby(1981)state that the timing of freeze-up and
formation of polynyi, the size of polynyi at maximum ice cover, and
the pattern of break-up and disappearance are important factors for
understanding ecological relationships. Using NOAA visible and
infrared imagery, Landsat imagery, and weekly ice composition maps
from the Ice Climatology and Applications Division of the Canadian
Atmospheric Service, they studied 16 polynyi in the Canadian
Archipelago from July to November, 1975-1977. They reported only
broad dates for formation and disappearance of the polynyi. They gave
no quantitative measurements of the areas.

Stringer (1982)measured the width and persistence of the Chukchi
Polynya for the years 1974-1981 using Landsat and NOAA imagery. The
Chukchi Polynya extends from Cape Lisburne to Pt. Barrow. A
qualitative correlation was found between average ice motion away from

the coast and the mean vector wind for all months except perhaps July.

Carleton (1980)mapped the recurring polynyi south of the Pt.Hope/Cape Thompson area using Landsat imagery. He was able to differentiate between open water and thin ice. He calculated areas for both the open water and thin ice regions and related their total size to the climatic factors of wind and temperature.

DATA AND ANALYSIS:

The Geophysical Institute has a library of NOAA images from 1974 to the present. Furthermore, a computerized program(Polar Satelite Image Digitizer) which enables one to rectify NOAA imagery to the USGS Alaska Map E and to calculate the areas of digitized features has been developed at the Geophysical Institute.

It appeared feasible to document the dates of appearance and disappearance of polynyi for the Bering and Chukchi Seas as Smith and Rigby did for the polynyi of the Canadian Archipelago as well as to quantitatively determine the areas and relate these areas to climatological data as Carleton did with the Pt. Hope/Cape Thompson polynya. Furthermore, Carleton's areas, derived fran much more detailed Landsat imagery, could be used to check the accuracy of the areas calculated by computer from the corrected NOAA images.

Nineteen polynyi [Figure 1 and Table 1) were identified. Two of these locations, the coast between Etol in Strait and Norton Sound and the Chukchi polynya, are cliff icult to categorize. At times they fit the standard definition of a polynya, and at other times, they would more properly be defined as shore leads. The feature f ran Etolin

Strait to Norton Sound was considered as one unit whether it appeared as a continuous shore lead or one or more distinct polynyi. The Chukchi polynya was divided into three roughly equal segments paralleling the coast between Cape Lisburne and Pt. Barrow. This was done so one could document the times when it was shore lead-like or polynya-like and hopefully discern some pattern for this type of behavior.

Polynyi B, E, H, J, Q, and W will be referred to here as the North Coast Polynya because they form off the north coasts of St. Matthew, St. Lawrence, and Nunivak Islands and of the Yukon Delta, Seward Peninsula, and Chukotsk Peninsula. They occur less frequently. They appear to. arise from a reversal of the predominant wind direction which is thought to come from the North or Northeast. Thus formation of" North Coast Polynyi "is hypothesized to result f ran a wind coming from the south. As this wind may be warmer than the ambient air at the higher latitudes and it may have traversed an extensive region' of ice free water in the southern Bering Sea, it may also be responsible for the extensive cloud cover observed when. these polynyi form.

Many polynyi form on the north, south, and eastern coast of the Chukotsk Peninsula. As the emphasis in this report was on polynyi occurring in Alaskan waters, only the polynya which occasionally forms north of the Peninsula was included as its formation appears to be related to the phenomena of reversal of the predominant wind direction mentioned above. This is called the Chukotsk Peninsula polynya. Otherwise the designation of individual polynyi is essentially identical to that found in Stringer (1981, 1982) and Smith and Rigby(1981).

The original intention was to digitize as many years of NOAA data as possible. The images were processed from January thru June on a daily basis; each polynya was designated as frozen, obscured by cloud cover, not available, or fused with the main body of open water (Tables 4-21).

Determining the area of' 19 polynyi on 180 individual days involves an upper limit of 3400 individual measurements per year. This number of measurements proved to be an insurmountable task for the total number of years of NOAA imagery available because of the time required to rectify sane imagery which displayed-extensive cloud cover. Therefore, in this work, only the years 1974, 1975, and 1976 were processed. In 1974 it was possible to digitize at least one polynya on 95 days of a possible 189. The numbers for 1975 and 1976 are 107 out of 181 and 131 out of 212.

Every available image was examined in an effort to obtain the most continuous record possible for each of the 19 polynyi. If a choice was possible, visible images were usually selected over thermal infrared. If further selection was possible, the choice was made on the basis Of the extent of distortion and/or the quality of the registry points visible.

Digitization of polynyi wasn' t uniformally straightforward. In January and February only IR imagery was available; frequently there was no imagery at all. The border between first year and thin ice and open water was hard to find. Sometimes a polynya would appear immediately off a coast as a dark band which would grade imperceptibly into the mass of pack ice. One might hypothesize that in these

situations the open water of the polynya was freezing as rapidly as it was being formed. In still other cases, a polynya was partially visible through light cloud cover. In these cases, one could occasionally verify that the substandard view of the polynya was suitable for digitization because it was compatible with completely clear views of the polynya either immediately before or after the image in question.

In other cases, the registry points were difficult to locate precisely. Difficulties in locating registry points resulted in polynyi being placed slightly out of alignment with the coastal. features with which they were associated. Fortunately this misalignment was more likely to occur in an east-west direction than in a north-south one, an important distinction when areas are being calculated based on a polar stereographic map like the Alaska Map E. It was concluded that minor misalignments did not change the area enough to be noticeable given the error inherent in the digitization itself.

Each polynya was digitized at least twice. This was to serve two purposes. First, it was desirable to learn how accurately one could reproduce the area of a given polynya under optimal conditions and under marginal conditions. Second, it allows one to differentiate between genuine daily area fluctuations and variability due to error in the method.

The following conclusions can be made: (1) It is hard to accurately measure areas of less than 200 square kilometers; the error is frequently greater than 10%; (2) Between 300 and 1000 square .

" kilometers the error is 10% or less, and (3) over 1000 square kilometers the error is much less than 10%.

Areas for the Cape Thompson/Point Hope Polynya which Carleton calculated using Landsat imagery were compared with areas calculated from NOAA imagery for the same day (Table 2).

Under ideal conditions where cloud cover is no impediment and where extent of the polynya is not ambiguous such as frequently occurs in June, agreement between areas calculated from Landsat and NOAA imagery is very acceptable (Table 2). Areas of greater than 2000 square kilometers agreed within 10% or less. Areas of less than 2000 square kilometers agreed less well. However, there were fewer of these smaller areas for comparison.

RESULTS:

A monthly comparison of the pattern of appearance and disappearance of the nineteen polynyi utilizing the daily records of the digitized polynya areas organized by the month in Tables 4-9 for 1974, Tables 10-15 for 1975, and Tables 16-21 for 1976 is given below.

JANUARY: Only in 1975 was imagery available. All of it was infrared imagery. On 20 out of 31 days imagery was either unavailable or so obscured by cloud cover as to be unuseable.

On January 2 two large polynyi of the order of 10,000 square kilometers were observed south of St. Lawrence and Nunivak Islands. Everything visible north of Bering Strait was frozen.

A week of clear weather between January 12th and 17th revealed polynyi south of of St. Lawrence "and Nunivak Islands, in Norton Sound, off the Seward Peninsula in the Cape Lisburne region and north of Pt. Lay. Some of them were quite extensive.

FEBRUARY: In 1974 virtually no imagery was available. In approximately the last week of February visible imagery became regularly available in 1975 and 19'76. This is the last month for which it was necessary to use infrared imagery for area Calculations. Eighteen of the nineteen polynyi were recorded at least once in 1975 and 1976. In 1976 there is a continuous record of area measurements for the Norton Sound polynya which spans 18 days; if one neglects one intervening cloudy image, the contiguous record extends for 25 days.

In 1975 many polynyi became quite large--of the order of 10,000 square kilometers in 1976 the largest polynyi were only half that size. In 1975 on February 8th, a huge linear polynya formed which extended from the north shore of Norton Sound to Pt. Lay, and on February 24 a second huge linear polynya was present fran the Bering Strait to Pt. Barrow.

A third conspicuous feature of 1975 is the frequent presence of the North Coast Polynyi hypothesized to be associated with reversal of the predominant wind direction. All of these polynyi except the one that forms to the north of St. Matthew Island were present on February 8th. The Yukon Delta polynya(J) could be seen for a period of 6 days with one intervening cloudy day; it was fused with other polynyi and the combined area was of the order of 10,000 square kilometers. The Kotzebue polynya(Q) could be seen for nine days

starting from February 8th including one intervening day for which there was no suitable imagery. In this period its area averaged approximately 10,000 square kilometers. During 1976 the Kotzebue polynya(Q) and the Chukotsk Peninsula polynya(W) were present at the end of February; the areas of the polynyi in 1976 were much smaller " than was observed in 1975.

MARCH: Imagery was unavailable for eight days in the beginning of March 1974, and three days were cloudy to the extent that no polynyi could be digitized. In 1975 ten days were cloudy and two were unavailable. In 1976 four days were cloudy.

The North Coast Polynyi were present frequentl y in the beginning of 1976 and somewhat less frequently in 1975. There are indications that the Kotzebue polynya (Q) might have been present through most of March 1976. As was noted earlier, one of the possible consequences of formation of a polynya such as the Kotzebue polynya because of a warm wind coming from the south which has passed over large regions of open water is that the formation may be associated with extensive cloud cover. Accordingly, in those cases where North Coast Polynyi are formed by the action of winds from the south, the accompanying increased cloud cover decreases the chances of observing the complete pattern of the formation and disappearance of these features. Thus while it is possible that the number and size of North Coast Polynyi in the beginning of March 1975 may have at least equaled if not exceeded those recorded in 1976, the extent of cloud cover in 1975 prevented documentation of this. On March 8th the Etolin Strait/Yukon 'Delta polynya(I) was fused with the Yukon Delta polynya (J) to form an area of open water of 14,000 square kilometers. Every other polynya

that could be observed on March 8th was a North Coast polynya. Thus it seems reasonable that this situation was present on the many cloudy days preceding and following March 8th. The same argument could be made for the period March 1-13, 1974.

St. Matthew and Nunivak Islands appear to always have some open water off' their coasts after mid-March.

APRIL: At least one polynya per day could be digitized for most of April for all three years. Many polynya in all three years have an almost complete daily record of area measurements.

In 1976 polynyi north of the Bering Strait were either frozen or small in area; few North Coast polynya formed anywhere.

In 1975 huge polynyi formed north of the Bering Strait for the first half of March. The area of these polynyi was roughly 25,000 square kilometers. The Yukon Delta polynya (J) and the Kotzebue polynya(Q) were present on at least a third of the days.

In 1974 polynyi associated with Nunivak and St. Matthew Islands became connected to the main body of ice free water in the southern Bering Sea by the end of April.

MAY: In 1974 there was only one completely cloud covered day. In 1975 there were seven days where imagery was not available and two days with complete cloud cover. In 1976 there were five days of complete cloud cover.

In 1974 St. Matthew, Nunivak , and St. Lawrence Islands and the Etolin Strait /Yukon Delta polynya were connected to the main body of ice free water in the southern Bering for the whole of May. In 1975 it appears likely that St. Matthew and Nunivak Islands were joined to ice free water in the southern Bering by mid-May but extensive cloud cover or lack of suitable imagery makes this difficult to determine. In 1976 it appears that St. Matthew, Nunivak and St. Lawrence Islands might have remained surrounded by ice somewhat later into May than was the case in 1974 and 1975. However, extensive cloud cover makes this difficult to judge.

No North Coast Polynyi were observed forming in 1974 or 1975. This phenomena may have taken place in 3976.. However, it is cliff icult to tell if what was observed was due to polynya formation or melt back of the ice edge.

The Norton Sound polynya (K) was well developed for the whole month of May 1974 and by the end of the month had connected with the main body of ice free water in the southern Bering Sea. Its area was between ten and twenty thousand square kilometers. In 1975 and 1976 the Norton Sound polynya was considerably smaller at this time of the year until the end of the month. It wasn't possible to determine if the Norton Sound polynya became connected with the ice free water of the southern Bering Sea in May of 1975 or 1976.

The group of polynyi north of the Bering Strait became quite large in 1975. A large polynya of approximately 30,000 square kilometers extended from Pt. Hope to Pt. Barrow during the last five days of May. While a similar polynya enlarged to 20,000 square

kilometers by the end Of 1974, it seems apparent that there was considerably more open water north of Pt. Hope in 1975 than in either 1974 or 1976. Finally there seems to be some indication" that open water may form more frequently, earlier and more extensively north of Pt. Hope than south of that location.

JUNE: In 1974 the Bering Sea was essentially open as far north as Bering Strait from June 1st on; in 1976 these conditions appeared June 6th. In 1976 the Norton Sound polynya (K), though fused with polynyi to the north, was still a distinct entity until June 14th. Not until June 26, was the imagery sufficiently cloud free to, document that the Bering Sea was essentially open water north to Bering Strait. It seems apparent that the ice went out later in 1976 than in 1975 or 1974.

Thus, it is evident that polynya formation in June is confined to . the Pt. Hope- Cape Lisburne area and north. For the first ten days of June 1975 a huge polynya from roughly Cape Thompson to Pt. Barrow attained an area of 50, 000 square kilometers. Extensive cloud cover for the rest of the month obscured the fate of this open water.

In 1974 and 1976 the pattern of polynya formation is that of many smaller, more polynya-like patches of open water in contrast to the huge shore-lead like feature observed in 1975.

JULY: No polynya were digiti.zed for 1975; 1975 wasa heavy ice year, and the ice remained off the coast north of Icy Cape for most of that summer. In 1974 open water extended from the Bering Sea north to Icy Cape by June 5th. In 1976 this wasn't observed until July 23rd. In 1976 the family of polynyi from Pt. Hope to Pt. Barrow were

always observed as small, discreet polynyi and not as the huge shore lead type present in M-15.

DISCUSSION:

There were several approaches taken in an attempt to relate the polynya formation patterns to cl imatic conditions

Certain generalizations can be made about the three years. 1976 contained a large number of days for which it was possible to obtain a continuous record of polynya formation. On the average, polynyi in 1976 tended to be small or frozen. The ice apparently went out later in the Bering Sea in 1976 than in the other years.

The most conspicuous feature of 1974 was. the early melt-back of the ice edge.

1975 was selected as the year for more intensi-ve study because so many large polynyi formed that spring.

The approaches considered for relating polynya formation to climatic events were 1) an attempt to correlate monthly weather changes at St. Paul Island, Nome, Kotzebue and Barrow with polynyi formation (Table 3) , 2) an attempt to correlate the weekly 700 mb maps published in Monthly Weather Review with polynya formation, and 3) an attempt to correlate daily weather changes at Nome, Kotzebue, and Barrow with some of the more dramatic polynya formation events in 1975.

JANUARY: Monthly temperature averages for St. Paul Island, Nome, Kotzebue and Barrow were 4 to 6° C colder than the 30 year averaged temperatures at these stations. The predominant direction of the wind was normal at each station in 1975; no 30 year averaged dominant wind direction is given for St. Paul Island. Nevertheless, a large polynya was present south of St. Lawrence Island for January 2. The weekly 700 mb pressure map for the. period December 31, 1974-January 4, 1975 showed a low extending over Alaska and the Arctic Ocean which directed cold air f rom the North. Wagner (1975) described this period as extremely cold. The pressure map for the period for which an extended record of polynyi formation was documented(January 12-17)showed a low in a similar position.

FEBRUARY: Monthly temperature averages at St. Paul Island and Nome in 1975 were 2° C colder than the 30year average; at Kotzebue and Barrow average temperatures were 3° C warmer than usual." 1974 and 1976 were 5 to 6° C colder than 1975 at Nome, Kotzebue, and Barrow. It would appear that the clear cold weather in 3976 was responsible for the long continuous records of polynyi formation noted earlier for that year.

Monthly predominant wind direction for the three locations was normal in 1975.

The 700 mb pressure map(Wagner, 1975) for February 4-8, 1975 shins a region of high pressure over mainland Alaska which implies a wind from the south over the Bering and Chuckchi Seas. Much"of the-imagery for the first week of February 1975 revealed the whole region was cloud-covered. The pressure map for February 11-15 implies a wind

from the North, a product of a region of high pressure stretching f rom off the Alaskan Coast to the Chukotsk Peninsula. This accounts for a clearing of cloud cover which allowed fairly complete daily records to be compiled for polynyi for the period February 8-16. Many of these polynyi were North Coast Polynyi. The pressure map for February 18-22 looks similar to the previous one. Cloud cover increased and not as many polynyi were observable. On the February 25-March 2 pressure map the low present on the previous maps has moved into the eastern Bering Sea.

Daily polynya records for February 1975 were inspected for February 8th and February 24th. On February 8th a large polynya was observed stretching fran the north shore of Norton Sound to Pt. Lay. On February 24th a huge polynya formed fran fran the Bering Strait to Pt. Barrow.

Wind and temperature records which seemed to explain observations around February 8th in a straightforward manner den't have as obvious an effect around February 24.

At Kotzebue prior to February 8, the winds were recorded as originating from the SE, S SW, or W and the temperatures were -10" C on the average; these conditions are departures f ran the norms. On February 8th, the winds shifted and now originated fran the N, NW or NE; the temperatures fell rapidly to below -20° C on the average. The days following were quite cold (-20 to -30° C), and the winds came fran the E or SE. This sequence of events fits the hypothesis that polynyi are f ormed by winds f ran the South under conditions of relatively warm temperatures and perhaps extensive cloud cover and then revealed by

subsequent periods of colder winds from the North which dissipate earlier cloud cover.

At Kotzebue on February 24 the temperatures were very cold(-30° C and lower) and a wind from the south or SW shifted to the originate from the NE by the end of the day. The succeeding days were characterized by winds from the N or NE and warmer temperatures(+12° C); preceding days were characterized by winds from the north which were either very cold(-30° C and lower) or warmer(+12° C) and periods of winds from the south with very cold temperatures.

At Pt. Barrow on February 8th winds were recorded as originating from the West and NW, and the temperatures were around -25* C which is still wamr than average for this time of the year. Prior to February 8th the winds were from the SE, S or SW and the temperatures were very cold(-30 to -35° C). The succeeding days were characterized by winds from the north and cold (-30° C).

MARCH: The monthly temperature average at St. Paul Island was 2° C colder than the 30 year average. The monthly temperature at Nome was average(approxirratel.y -14° C); monthly temperatures at Kotzebue and Barrow were 3 to 4" C higher than average. Monthly predominant wind direction was from the east; normal for Nome. At Kotzebue the 30 year predominant wind direction is listed as East for March; in 1975 this wind was from the ESE. At Barrow the 30 year predominant wind direction is from the ENE; in 1975 this wind was fran due east.

Comparison of the monthly 700 mb pressure map for March 1975 (Taubensee, 1975) with pressure maps of the years for which NOAA imagery is available and for which Monthly Weather Review publishes a monthly weather map (197 4-1981) reveals that a high pressure center commonly located north of the Chukotsk Peninsula was located north of the MacKenzie Delta in 1975. The appearance of a region of high pressure over Bering Strait for a week or two is fairly common having been present for five of the eight years investigated. March 1975 displayed this unusual behavior for the the whole month. Monthly pressure maps for March commonly have a low pressure center situated slightly south of the Bering Strait which was also the case in 1975.

The weekly pressure maps (Taubensee, 1975) for the first three weeks in March document the formation of this high on the Alaska/Yukon border and its progress north to a position off the MacKenzie Delta. For the last week in March the region of high pressure remained relatively stationary and in the first week in April, it moved slightly to the west. Thus this region of high pressure remained in an unusual position for approximately five weeks. As was noted earlier much of March was character ized by extensive cloud cover. However, the polynyi that were visible were frequently the North Coast Polynyi which form in Norton Sound and north of the Bering Strait. By contrast St. Matthew, St. Lawrence, and Nunivak Islands showed typical polynya formation to the south as might be dictated by the typical weather pattern displayed by the March monthly 700 mb pressure map for the Bering Sea.

March 8th and March 24th seem likely candidates for studying daily weather effects. The Etolin Strait-Yukon Delta polynya fused with the Yukon Delta polynya , the Kotzebue polynya and the Chukotsk Peninsula polynya were all observable on the same day.

APRIL: Monthly temperature averages were 2° C colder than normal for St. Paul Island, Nome, Kotzebue, and Barrow. The predominant wind direction at Kotzebue was normal when compared with the 30 year average (Table 3) . At Barrow the normal wind direction is from the NE, but in 1975 the predominant wind came from ESE. At Nome the normal wind direction is from the north, but in 1975 the predominant wind came from the NE. The monthly 700 mb pressure map (Wagner, 1975) is not conspicuously different from that recorded for April in other years.

Inspection of the weekly 700 mb pressure maps (Wagoner, 3375) f or April 1975 reveals the region of high pressure north of the MacKenzie Delta in March moved west to a position north of Alaska the first week of April and into a position north of western Siberia in the second week. This implies winds fran the south or east in the Chukchi Sea for the first week and winds from the north in the second week.

This period in the polynya record (Table 13) is characterized by formation of North Coast Polynyi and the enlargement of the Chukchi polynya to 25,000 square kilometers for at least the period f ran April 2 thru April 12. After April 15 the Chukchi polynya had completel y frozen over or closed decreasing from 22,000 square kilometers to zero in 48 hours. For the remainder of April this polynya remains small, frozen, or closed. The Kotzebue polynya traces a similar pattern.

The Yukon Delta polynya, a North Coast. Polynya, was small in area or frozen prior to April 15 and became much larger after April 15. This behavior, contrasted to that described above, implies that climatic events effecting polynya formation north of Bering Strait may be different from those effecting polynya formation to the south.

Daily temperature and wind records at Kotzebue and Barrow are not easy to interpret,

MAY: Monthly temperature averages were approximately 1° C lower in 1975 than the 30 year average at St. Paul, Nome, and Kotzebue; the monthly temperature average was normal at Barrow(-7° C). Monthly predominant wind direction was normal at Nome, Kotzebue and Barrow (Table 3). Except for being somewhat colder than average (and even here the departures weren't as extreme as they were in previous months)May is apparently an unexceptional month.

Weekly 700 mb pressure maps(Dickson, 1975)show the presence of a high pressure area near Banks Island for the week of May 6-10. No North Coast Polynya are recorded for May 1975. After May 12 the Chukchi polynya has fused and is quite large.

Daily temperature and wind direction for Kotzebue and Barrow are quite variable for mid-May.

It is not possible to determine if the increase in size of the Chukchi polynya is due to location of a high pressure region near Banks Island, to the impending break-up, or sane undetermined cause.

JUNE: The ice edge has advanced to the entrance to Norton Sound by the first of the month and within Kotzebue Sound by the end of the month. Monthly temperatures at Nome and Kotzebue are 2 to 3° C lower than normal: at Barrow the temperature is normal (8° C). Predominant winds are normal at all locations (Table 3) .

Weekly 700 mb pressure maps don' t show any anomalous high pressure region (Taubensee, 1975) .

It appears possible that_ the events recorded for polynya formation in June 1975 are those of a typical break-up season.

The f ollowing conclusions can be made :

1) The large size of the Chukchi Polynya in March of 1975 is unusual; at this point it seems possible that such an event may occur only once in a decade. However, one must investigate a greater number of spring break-ups than was done here to adequately document this..

2) A region of high pressure which forms anywhere over the Alaskan landmass or north of Alaska or the MacKenzie Delta and persists for more than two weeks is an unusual event for March.

3) Whenever the above occurs, there . will be an increased probability for the formation of polynyi in atypical locations such as the North Coast Polynyi or of atypical size for the time of the year such as is demonstrated by the formation of the Chukchi polynya in March and April 1975.

4) Unusual polynya formation north of Bering Strait may occur independently of such phenomena south of Bering Strait. Polynya formation south of the Bering may have different climatic causes than that north of the Strait.

5) Although there are indications that North Coast Polynyi " development and extensive cloud cover in the Bering and Chukchi Seas are related to a wind from the south, on the whole, climatic variables such as temperature and wind data at specific weather stations and for specific time periods have not been adequately related to polynya formation in this work.

6) The regions of high pressure mentioned above are of interest not only because of what appears to be their importance in polynya formation; they also could be influential in the appearance of other unusual phenomena in the Arctic Ocean. For example in March of 3975 huge sections of the fast ice off the MacKenzie Delta broke off, drifted to the west, and collided with the pack ice off the Kongakut River in NE Alaska. (Stringer, 1985) .
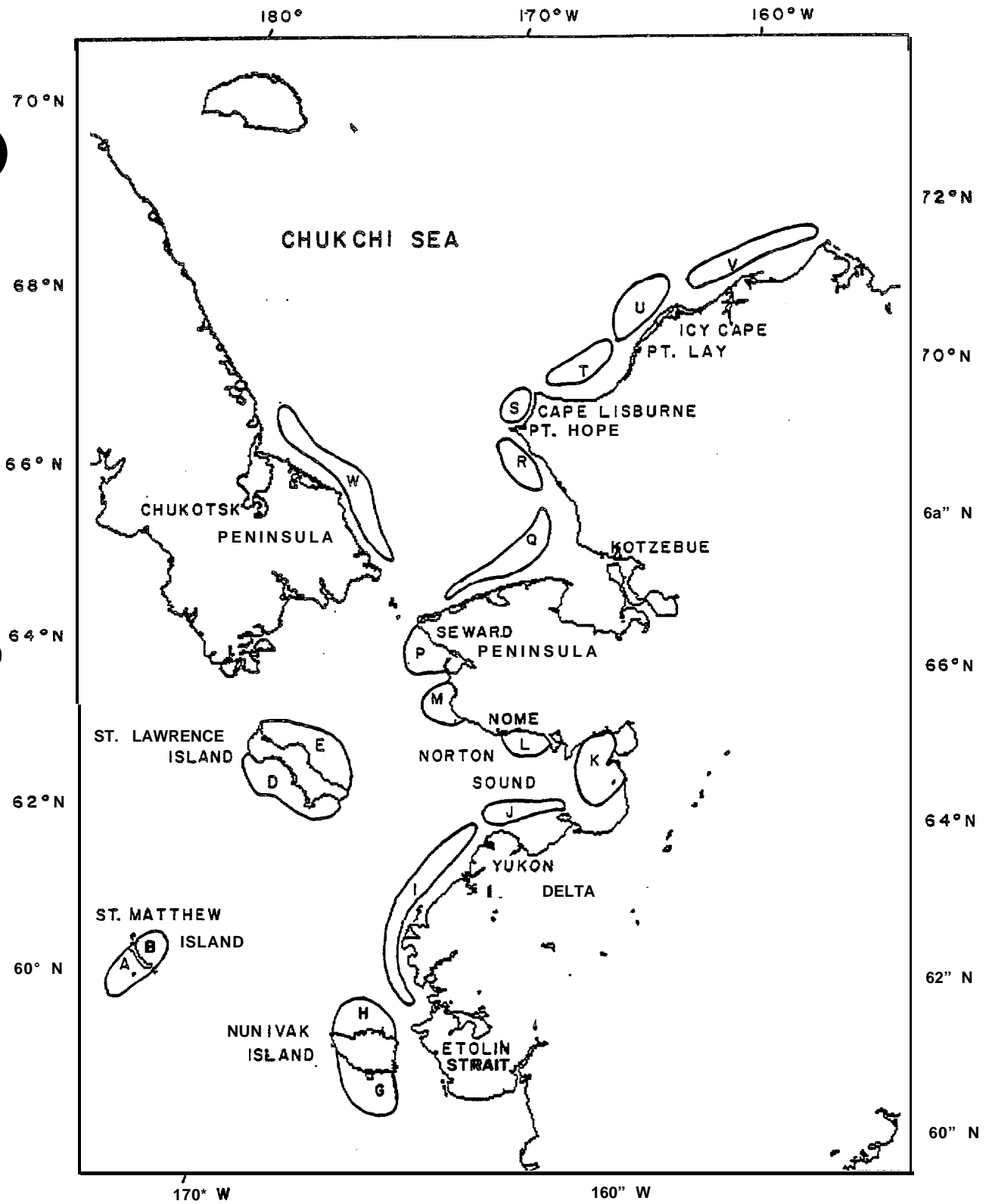
Figure 1.   Location of nineteen **polynyi** in the **Chukchi** and Bering seas.

Table 1: Identification of Polynyi

Location of Polynyi	Coded Designation on Alaska Base Map
St. Matthew Island, South	A
St. Matthew Island, North	B
St. Lawrence Island, South	D
St. Lawrence Island, North	E
Nunivak Island, South	G
Nunivak Island, North	H
Etolin Strait-Yukon Delta	I
Yukon Delta	J
Norton Sound	K
Nome	L
Seward Peninsula, South	M
Seward Peninsula, North	P
Kotzebue	Q
Cape Thompson-Pt. Hope*	R
Pt. Hope-Cape Lisburne	S
Cape Lisburne to Pt. Lay**	T
Pt. Lag to Icy Cape**	U
Icy Cape to Pt. Barrow**	V
Chukotsk Peninsula	W

* Carleton(1975)

** Chukchi Polynya(Stringer, 1982)

Table 2: Comparison of Areas calculated from NOAA imagery with Areas calculated from Landsat Imagery.

YEAR	IMAGE DATE	AREAS (square kilometers) Landsat(Carleton, 1980)	NOAA			DISCUSSION
1974	1 March	63	clouds			Carleton believes area was underestimated.
	20 March	2280	2100			
	7/8 April	4125	2500	±	150	NOAA area underestimated because of cloud cover.
	13 May	1450	1 000	±	50	Landsat area. may be underestimated.
	17 June	4500	5200	±	150	Polynya appears to be fused with the Chukchi polynya on the NOAA imagery.
1975	12 April	560	Boo	±	100	Landsat area may be underestimated.
	16 May	1290	1100	±	50	Landsat area may be underestimated.
	3/5 June	1650	600			Polynya appears to be fused with the Chukchi polynya area may be underestimated on both types of imagery.
1976	10 Febraury	1800	2000	±	20	
	17 March	4235	4400	±	146	
	22 April	475	350	±	60	
	10 May	1850	i 500	±	100	
	15 June	2660	7000			Polynya aappears to be fused with the Chukchi polynya.

| | Thirty Year Average | | | | 1974 | | | 1975 | | | 1976 | |
MONTH	Prevailing Wind Direction	Aver. Temp. °C	Mean Wind Speed	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)
Jan		-3.3	20.8	060	-3.1	14.6	040	-8.0	5.3	050	-5.&	13.2
Feb		-5.0	21.8	020	-9.5	12.4	020	-9.3	9.1	040	-12.8	14.2
Mar		-4.6	20.1	070	-3.4	7.8	010	-6.8	2.6	340	--10.7	3.6
Apr		-1.9	19.2	020	-3.9	7.1	290	-2.6	2.6	020	-8.2	5.2
Nay		i-l.6	16.2	090	+1.8	3.3	030	+0.1	9.0		-o.7	
Jun		+4.9	14.3	330	+4.1	6.7	350	+3.4	2.7		+4.4	

Table 3-b.   Comparison of Thirty year averaged Climatological Data with Yearly Climatological Data at Nome.

| | Thirty Year Average | | | | 1974 | | | 1975 | | | 1976 | |
MONTH	Prevailing Wind Direction	Aver. Temp. °C	Mean Wind Speed	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)
Jan	E	-14.4	11.7	060	-15.1	6.5	070	-18.2	4.7	040	-17.8	5.6
Feb	NE	-15.0	11.3	040	-22.6	5.1	060	-16.6	7.3	050	-25.6	2.4
Mar	E	-13.7	10.5	040	-12.0	7.2	090	-13.8	7.9	090	-16.i	4.4
Apr	N	-7.2	10.9	040	-6.2	5.2	090	-10.3	4.3	050	-12.4	3.6
May	N	+1.6	10.4	060	+3.4	1.7	360	+1.1	2.7	270	+0.6	1.7
Jun	WSW	-r-7.4	10.i	270	+6.2	6.o	240	+5.8	3.7	i 90	+5.El	3.1

These data were taken from "Local Climatological Data", publications prepared from weather observations made at St. Paul Island, Nome, Kotzebue and Barrow by the Environmental Data Service of the National Oceanic and Atmospheric Administration.

Resultant wind direction is recorded in 10 degree increments clockwise from true north.

Table 3-c. ⬤ parison of Thirty year averaged Climatol⬤ Data with Yearly Climatological Data a⬤ ebue.

| MONTH | Thirty Year Average | | | | 1974 | | | 1975 | | | 1976 | |
	Prevailing Wind Direction	Aver Temp. °C	Mean Wind Speed	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)
Jan	E	-19.8	14.5	060	-19.0	3.5	100	-23.2	6.7	070	-20.6	7.1
Feb	E	-20.2	12.8	030	-25.5	1.7	090	-18.9	6.8	350	-27.6	1.6
Mar	E	-10.1	12.6	050	-17.9	4.9	110	-14.9	9.1	090	-17.3	4.9
Apr	ESE	-10.6	12.8	060	-11.1	2.1	120	-12.8	2.5	180	-14.4	0.7
May	W	-0.7	10.9	270	-1.1	4.1	290	-2.1	6.6	290	-1.1	7.5
Jun	W	+6.4	12.3	280	+4.2	10.8	270	+3.1	8.7	260	+4.1	6.0

Table 3-d. Comparison of Thirty year averaged Climatological Data with Yearly Climatological Data at Barrow.

| MONTH | Thirty Year Average | | | | 1974 | | | 1975 | | | 1976 | |
	Prevailing Wind Direction	Aver. Temp. °C	Mean Wind Speed	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)	Resultant Wind Direction	Aver. Temp. °C	Resultant Wind Speed(mph)
Jan	ESE	-26.0	11.2	280	-28.9	5.6	100	-32.4	2.2	070	-28.3	2.3
Feb	E	-28.1	10.9	310	-33.5	2.3	080	-25.3	2.9	290	-30.5	1.8
Mar	ENE	-26.2	11.1	060	-28.9	2.6	090	-21.8	8.2	050	-26.3	5.0
Apr	NE	-18.3	11.5	060	-22.2	6.2	110	-20.3	1.8	080	-18.9	4.9
May	ENE	-7.2	11.6	090	-7.7	5.7	080	-7.2	8.7	060	-8.2	8.8
Jun	E	+0.6	11.3	10CJ	-1.1	2.6	090	+0.9	5.5	080	+0.8	3.2

These data were taken from "Local Climatological Data", publications prepared from weather observations made at St. Paul Island, Nome, Kotzebue and Barrow by the Environmental Data Service of the National Oceanic and Atmospheric Administration

Resultant wind direction is recorded in 10 degree increments clockwise from true north.

Table 4. Areas of Nineteen Polynyi in Chukchi and Bering Seas in 1974.

FEBRUARY	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	W
01/032	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
02/033	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
03/034	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
04/035	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
05/036	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
04/037	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
07/038	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
0(3/039	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
09/040	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
10/041	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
1 i /042	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12/043	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
13/044	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14/045	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
1 5/046	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16/047	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17/048	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15/049	N	"N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19/050	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
20/051	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
21 /052	c	c	c	c	c	c	F	F	F	F	F	F	F	F	F	F	F	C
22/053	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
23/054	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
24/055	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
25/056	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
26/057	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
27/058	F	F	F	F	F	F	c	c	c	C	c	c	c	c	c	C	C	c	C
28/059	c	c	C	c	c	c	c	c	c	C	C	c	c	c	C	C	c	C	c

C: Cloudy; F: Frozen; N: No suitable imagery; O: Open water.
x: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.
iii/(4) indicates an area of 11100 square kilometers,

Table 5. Areas of Nineteen Polynii in Chukchi and Bering Seas in 1974.

MARCH	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	V	W
01/060	N	z	N	N	Z	N	N	N	N	N	N	N	N	N	N	N	N	N	N
02/061	N	N	N	N	Z	N	N	N	N	N	N	N	N	N	N	N	N	N	N
03/062	z	N	N	z	F	N	N	N	N	N	N	N	N	N	N	N	N	N	N
04/063	u	C	505	F	F	F	F	F	176	F	F	F	F	F	F	F	F	C	F
05/064	N	N	N	N	Z	Z	N	N	N	N	N	N	N	N	N	N	N	N	N
06/065	N	N	F	F	F	F	F	C	C	C	F	F	F	F	F	F	F	F	F
07/066	N	N	N	N	Z	Z	N	N	N	N	N	N	N	N	N	N	N	N	N
08/067	N	z	N	N	Z	Z	N	N	N	N	N	N	N	N	N	N	N	N	N
09/068	N	z	N	F	Z	Z	F	N	N	N	N	N	458	N	N	N	N	N	N
10/069	N	u	F	C	494	F	C	C	F	F	C	C	C	C	C	C	C	C	C
11/070	C	N	C	F	C	u	F	F	C	C	C	C	F	C	C	C	C	C	C
12/071	u	F	F	F	446	F	1660	F	235	890	F	F	F	F	472	F	658	F	2810
13/072	497	F	467	F	N	N	361	F	692	F	33	F	F	F	127	F	F	F	N
14/073	1140	N	2770	F	659	F	3760	F	685	244	373	F	F	954	368	98	325	F	N
15/074	N	C	4860	F	C	C	1180	F	1420	123	623	F	F	1190	62	260	569	F	N
16/075	C	C	N	z	C	C	C	C	3590	X	1100	F	F	376	831	483	F	F	N
17/076	u	u	9620	F	C	C	4760	F	C	C	2430	X	C	534	1272	C	628	F	C
18/077	Uzu	N	C	C	C	u	C	C	771	F	C	C	C	502	251	831	F	F	C
19/078	u	C	C	C	C	37	8060	C	C	C	C	C	F	1000	F	F	F	F	F
20/079	u	u	3680	F	F	u	2000	F	C	C	C	C	C	2070	F	F	F	F	C
21/080	u	C	C	C	C	u	C	C	3920	X	214	C	C	C	C	C	C	F	C
22/081	u	u	C	C	C	u	C	C	C	C	C	C	C	C	C	C	C	F	C
23/082	u	C	C	C	C	u	C	C	C	C	C	C	C	C	C	F	F	C	C
24/083	u	u	C	C	C	u	C	C	C	C	C	C	C	C	C	F	F	C	C
25/084	z	C	C	C	C	C	C	C	C	X	C	X	C	C	C	C	C	F	C
26/085	9110	F	C	F	u	C	2.90 (4)	F	7670	X	1640	X	F	182	F	C	204	F	C
27/086	7970	F	4290	C	8250	X	3.07 (4)	F	8040	x	630	X	C	2280	36	F	F	F	F
28/087	N	N	C	C	9200	X	4.22 (4)	F	9220	X	1900	X	F	1910	C	F	F	F	F
30/089	N	F	N	N	N	N	N	N	N	N	N	N	C	23-a0	F	F	F	F	N
31/090	8970	F	3060	F	F	2.21 (4)	X	F	7730	X	C	C		2200	C	F	F	F	C

C: Cloudy; F: Frozen; N: No suitable imagery; O: Open water.

X: The number to the left of an x or many x's is the total area in square kilometers of two or more fused polynyi.

1.11/(4) indicates an area of 11100 square kilometers.

Table 6. Areas of Nineteen Polynyi in the Chukchi and Bering Seas in 1974.

APRIL	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	s	T	u	V	w
01/091	1.37(4)	F		c	3.90(4)	x	X	F	9740	x	.	c	F	2010	35s	93	F		F
02/092	1.17(4)	F	7220	F	5.46(4)	x	x	F	1.12(4)	x	2340	x	F	1950	222	F	F	F	F
03/093	N	N	N	N	4280	c	c	F	9800	x	2170	x	F	c	F	F	F	F	N
04/094	c	c	c	c	C	c	c	c	c	C	c	c	c	c	F	F	F	F	F
05/095	c	c	C	c	C	c	c	8880	x	x	1720	x	F	2660	295	715	1220	F	F
06/096	7560	F	c	c	1.39(4)	1.66(4)	x	9960	x	x	c	c	F	2400	268	c	c	c	F
07/097	8420	F	3090	F	1.36(4)	c	c	1.10(4)	x	x	5240	x	F	2250	32a	c	c	c	F
08/098	N	N	N	N	1030	c	c	c	c	c	2910	x	c	c	c	F	F	F	c
09/099	c	c	c	c	C	c	529	1.24(4)	X	x	2060	x	F	2420	F	F	F	F	F
10/100	c	c	c	c	C	c	c	F	8750	x	2840	x	F	1770	1a2	F	F	F	F
11/101	c	C	2970	F	C	c	c	c	8190	x	2320	x	F	2920	310	F	54	F	F
12/102	3370	F	6320	F	4.14(4)	x	x	F	1.13(4)	x	2690	x	F	2420	C	F	F	F	F
13/103	716	F	5750	F	C	c	c	c	8460	x	c	c	c	2530	C	F	1610	c	F
14/104	436	c	c	c	C	c	c	c	9510	x	2540	x	F	644	429	c	c	c	F
15/105	c	c	1.22(4)	F	C	c	c	c	1.03(4)	x	2520	x	c	c	412	c	c	c	c
16/106	c	c	c	c	C	c	c	c	8390	x	731	c	c	378	286	c	c	c	c
17/107	c	c	3850	c	C	c	c	c	1.07(4)	x	1590	163	c	c	c	c	c	c	c
18/108	1950	F	2680	c	C	c	c	c	8480	x	2220	x	c	2150	311	c	c	c	F
19/109	2700	c	c	c	C	c	c	c	9730	x	c	c	c	2680	C	F	F	F	c
20/110	2340	F	8140	c	C	c	c	c	1.32(4)	x	4780	x	F	261	144	F	F	F	F
21/111	2700	F	5270	c	C	c	c	c	9880	x	1720	x	F	332	C	c	c	c	F
22/112	c	c	c	c	C	c	c	c	c	c	3500	x	F	3630	86	F	F	F	F
23/113	2550	c	c	c	C	c	c	c	c	c	c	c	c	3740	c	c	186	c	c
24/114	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
25/115	c	c	c	c	C	c	c	7920	x	x	C	c	c	c	c	c	c	c	c
26/116	c	c	c	c	C	c	c	9590	x	X	C	c	c	c	312	172	168	F	c
27/117	c	c	6090	c	O	o	o	1.23(4)	x	x	251	F	F	F	180	180	717	F	F
28/118	c	c	9.01(4)	x	C	c	c	F	9300	x	9a	F	F	F	200	520	1740	F	F
29/119	o	o	o	o	O	o	o	F	1.14(4)	x	F	F	F	F	204	4a2	1860	1400	F
30/120	O	0	7.85(4)	x	O	0	0	F	1.28(4)	x	199	367	F	F	442	4170	x	x	F

c: cloudy;   F: Frozen;   N: No suitable imagery;   0: Open water

x: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

ill/(4) indicates an area of 11100 square kilometers.

MAY	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	u	v	W
01/121	o		"o	o	O	O	o	F	1.16 (4)	· "	396	741	F	139	279	2240	X	F	
02/122	O	J	o	Q	0	0	0	F	1.01 (4)	X	S38	756	F	122	189	F	2170	1 870	
03/123	O	o	0	Q	0	0	0	F	1.36 (4)	x	698	858	F	F	195	F	2480	3010	F
04/124	O	0	0	o	0	0	0	F	1.53 (4)	x	609	838	F	c	238	F	1880	4860	F
05/129	O	O	0	O	0	0	0	F	1.83 (4)	x	1330	1440	F	256	F	c	c	c	F
06/126	O	0	0	o	0	0	0	F	1.42 (4)	x	1650	1910	F	279	F	F	F	F	F
07/127	0	0	0	Q	0	0	0	F	1.68 (4)	x	1990	1610	F	347	70	F	490	F	
08/128	0	0	0	Q	0	0	0	c	C	c	1470	x	F	290	192	F	830	297	
09/129	0	0	0	O	0	0	0	c	C	c	c	c	F	65	551	F	1930	F	
10/130	O	0	0	0	0	0	0	c	C	c	F	F	F	F	806	2590	x	1120	
11/131	0	O	0	O	0	0	0	F	1.45 (4)	x	c	F	F	F	Boo	3440	x	2780	
12/132	0	0	0	O	0	0	0	c	C	c	1040	1530	F	300	728	6490	x	1700	
13/133	0	0	o'	O	0	0	0	F	1.72 (4)	x	2400	x	F	379	5B3	5920	x	1440	
14/134	O	0	0	0	0	0	0	F	1.68 (4)	x	4300	x	F	572	290	C	c	c	
15/135	O	0	0	0	0	0	0	c	C	c	c	c	c	269	239	5990	x	721	
16/136	0	0	0	0	0	0	0	c	C	c	c	c	c	c	290	C	c	c	
17/137	0	0	0	0	0	0	0	c	C	c	c	c	c	c	c	c	c	c	
18/138	0	0	0	0	0	0	0	c	C	c	c	c	F	c	519	5130	x	c	
19/139	0	0	0	0	0	0	0	c	C	c	c	c	F	F	713	6180	x	c	
20/140	0	0	0	0	0	0	0	F	1.99 (4)	x	388	c	F	F	796	7220	x	c	
21/141	0	O	0	0	0	0	0	F	1.54 (4)	x	x	c	F	F	F	6160	x	F	
22/142	0	0	0	0	0	0	0	F	2.10 (4)	x	x	c	F	F	866	5520	x	F	
23/143	0	0	0	0	0	0	0	F,	2.87 (4)	x	x	c	F	121	2020	8880	x	x	
24/144	0	0	0	0	0	0	0	F	2.08 (4)	x	144	1130	F	207	1.20 (4)	X	x	x	
25/145	0	0	0	0	0	0	0	c	C	c	c	c	F	49	1.59 (4)	X	x	x	
26/146	0	0	0	0	0	0	0	c	2.25 (4)	x	x	c	F	100	1.84 (4)	X	x	x	
27/147	0	0	0	0	0	0	0	c	2.30 (4)	x	x	c	F	F	1.77 (4)	X	x	x	
28/148	0	0	0	Q	0	0	0	c	C	c	c	c	F	100	1.57 (4)	X	x	·X	
29/149	0	0	0	o	0	0	0	o	C	c	c	c	F	F	1.92 (4)	X	x	x	
30/150	0	0	0	0	0	0	0	0	0	o	o	o	F	204	2.03 (4)	X	x	x	
31/1s1	0	0	0	0	0	0	0	0	0	0	0	0	F	223	2.02 (4)	X	x	x	

C: Cloudy; F: Frozen; N: No suitable imagery; O : Open water.

x: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

1. 11/(4) indicates an area of 11100 square kilometers.

Table B.   Areas of Nineteen Polynyi in Chukchi and Bering Seas in 1974.

JUNE	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	w	W
01/152	o	o	o	o	o	0	o	o	0	0	0	0	C	219	1.39 (4)	x	x	C
02/153	0	0	0	0	0	o	0	0	0	0.	0	0	C	374	1.13 (4)	x	x	C
03/154	D	0	0	0	0	0	0	0	0	0	o	0	C	c	c	C	c.	C
04/155	o	0	0	0	0	a	0	0	0	0	0	0	C	1720	1.09 (4)	X	x	F
05/156	0	0	0	0	0	o	0	o	o	0'	0	0	C	1690	9140	x	x	F
06/ 157	0	0	0	0	0	0	0	0	0	0	0	o	C	2100	1.42 (4)	x	x	F
07/158	0	0	0	0	0	0	0	0	0	0	0	0	C	c	c	C	C	C
08/159	0	0	0	0	0	0	o	o	o	0	0	0	F	40	747	6390	186	F
09/160	0	0	0	0	0	0	0	0	0	0	0	0	F	F	775	6950	x	288
10/161	0	0	0	0	0	0	0	0	0	o	0	0	c	c	C	C	c	c
11/162	0	0	0	0	0	c1	0	0	0	0	0	0	c	c	c	C	c	c
12/163	0	0	0	0	0	0	0	0	0	0	o	0	C	c	c	c	c	c
13/164	0	0	0	0	0	0	0	0	0	0	0	0	c	c	c	c	c	c
14/165	0	0	0	0	0	0	0	0	0	0	0	0	c	c	c	c	c	c
15/166	0	0	0	0	0	0	0	0	0	o "	0	0	c	R	261	1300	c	c
16/167	0	0	0	0	0	0	0	0	0	o	0	0	F	155	c	c	c	c
17/168	0	0	0	0	0	0	0	0	0	0	0	0	c	400	47?0	x	x	V
18/169	0	0	0	0	0	0	0	0	0	0	0	0	F	304	c	7309	x	F
19/170	0	0	0	0	0	0	0	0	0	0	0	0	c	F	c	6940	x	1460
20/171	0	0	0	0	0	0	0	0	0	0	0	0	F	F	c	5160	x	F
21/172	0	0	0	0	0	0	0	0	0	o	0	0	F	F	1.07 (4)	x	x	F
22/173	0	0	0	0	0	0	0	0	0	0	0	0	F	c	1.00 (4)	x	x	365
23/174	c	0	0	0	0	o	0	0	o	0	0	0	F	F	1.74 (4)	x	x	595
24/175	o	0	0	0	0	0	0	0	0	0	o	0	0	F	2.19 (4)	x	x	x
25/176	0	0	0	0	0	0	0	0	0	0	0	0	0	F	2.57 (4)	X	x	x
26/177	0	0	0	0	0	0	0	0	o	0	0	0	0	c	c	c	C	C
27/178	0	0	0	0	0	0	0	0	0	D	0	o	0	c	C	C	C	C
2(3/ 179	ü	0	0	0	0	0	0	0	0	0	0	0	0	c	c	C	C	"c
29/180	o	0	0	0	0	0	0	0	0	0	0	0	0	c	c	c	C	F
30/181	0	0	0	0	0	0	0	0	0	o	0	0	0	1.94 (4)	X	X	x	C

c: Cloudy;   F: Frozen;   N: No suitable imagery;   O: Open water.

X: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

i. 11/(4) indicates an area of 11100 square kilometers.

Table 9. Areas of Nineteen Polynyi in Chukchi and Bering Seas in 1974.

JULY	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	W
01/183	O	O	O	O	O	O	O	O	O	O	O	O	O	F	1.94 (4)	X	C	F
02/184	o	O	O	O	O	O	O	O	O	O	O	O	o	C	C	C	C	C
03/185	o	O	O	O	O	o	O	' O	O	O	O	O	O	1.75 (4)	x	x	x	C
04/186	o	O	O	O	O	O	O	O	O	O	O	o	O	N	N	N	N	N
05/187	o	D	o	O	O	O	O	O	O	O	O	O	O	O	O	O	O	F

c: Cloudy; F: Frozen; N: No suitable imagery; O: Open water.

x: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

i. 11/(4) indicates an area of 11100 square kilometers.

Table 10. Areas of Nineteen Polynyi of the Chuckchi and Bering Seas in 1975.

JANUARY	A	B	D	E	G	H	I	J	K	L	M	P	G	R	S	T	U	V	W
01/001	N	N	Z	N	Z	N	N	N	N	N	N	N	N	N	N	N	N	N	N
02/002	F	F	2.74(4)	C	.18(4)	F	F	C	C	C	C	C	F	F	F	F	F	F	F
03/003	Z	N	Z	N	Z	N	Z	N	N	N	N	N	N	N	N	N	N	N	N
04/004	Z	N	N	N	Z	N	Z	N	N	N	N	N	N	N	N	N	N	N	N
05/005	Z	N	N	N	Z	Z	N	N	N	N	N	N	N	N	N	N	N	N	N
06/006	Z	N	Z	N	Z	Z	Z	N	N	N	N	N	N	N	N	N	N	N	N
07/007	Z	N	Z	N	Z	Z	Z	N	N	N	N	N	N	N	N	N	N	N	N
08/008	Z	N	Z	N	N	Z	Z	N	N	N	N	N	N	N	N	N	N	N	N
09/009	N	N	N	N	N	N	C	N	N	N	N	N	N	N	N	N	N	N	N
10/010	C	C	C	C	C	C	C	F	F	F	C	C	F	F	F	F	F	F	C
11/011	N	N	Z	N	N	N	Z	N	N	N	N	N	N	N	N	N	N	N	N
12/012	N	N	z	N	N/F	F	F	F	1920	530	3840	X	F	2050	569	F	F	1200	F
13/013	N	N	7.66(4)	F	5240	F	F	F	1630	580	5550	X	X	5070	206	F	2480	1490	F
14/014	N	Z	2090	F	Z	z	F	F	1610	117	6240	X	X	3540	81	F	2340	1870	F
15/015	Z	Z	1.62(4)	F	Z	455	F	F	2590	954	8830	X	x	4740	94	F	2350	0 m3	F
16/016	N	N	4110	C	N	N	F	F	C	C	1.11(4)	X	X	4720	F	F	F	F	F
17/017	C	C	C	C	C	C	C	C	C	u	C	C	C	873	194	F	556	3770	F
18/018	N	z	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19/019	C	u	C	C	C	C	C	C	C	u	C	C	C	C	C	C	C	C	C
20/020	C	u	u	u	C	u	C	C	C	C	C	C	C	C	C	C	C	C	C
21/021	C	u	C	u	C	u	C	C	C	C	C	C	C	C	C	C	C	C	C
22/022	C	u	u	u	C	C	C	C	C	C	C	u	C	C	C	C	C	C	C
23/023	C	C	C	C	C	C	C	C	C	C	C	u	C	C	C	C	C	C	C
24/024	C	C	u	u	C	u	C	C	C	u	C	u	C	C	C	C	C	C	C
25/025	C	u	u	u	C	u	C	C	C	C	C	u	C	C	C	C	C	C	C
26/026	C	C	C	C	C	C	C	C	C	u	C	C	C	C	C	C	C	C	C
27/027	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
28/028	C	C	C	C	3980	C	C	F	218	F	C	C	2330	N	N	N	N	N	N
29/029	C	C	C	C	C	C	C	C	311	C	C	C	720	C	C	C	C	N	C
30/030	C	u	u	u	C	C	C	C	C	C	C	C	C	C	C	C	C	6000	C
31/031	C	u	u	u	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

C: Cloudy; F: Frozen; N: No suitable imagery; O: Open water.

X: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

1.11/(4) indicates an area of 11 square kilometers.

Table Ii. Area of Nineteen Polynyi i ... Chukchi and Bering Seas in 1975.

FEBRUARY	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	V	W
01/032	c	c	C	c	c	c	c	c	c	·C	c	C	C	c	C·	C	C	C	C
02/033	c	c	c	c	c	c	c	c	C	c	C	c	C	c	c	C	C	c	C
03/034	C	c	c	c	c	c	c	c	c	C	C	C	C	C	C	C	C	c	C
04/035	c	c	c	c	c	c	c	C	C	c	C	C	C	c	C	C	C	C	c
05/036	C	c	c	c	c	c	c	c	C	c	c	C	C	c	c	C	c	c	c
06/037	C	C	c	c	c	C	c	c	c	c	c	C	C	c	c	C	c	c	c
07/038	c	c	c	c	c	c	c	c	196	c	c	c	C	c	c	5430	F	F	6500
08/039	N	N	F	3060	F	4190	1.20 (4)	x	x	F	1.49 (4)	x	X	x	x	X	F	F	5900
09/040	N	N	c	c	F	5020	1.92 (4)	x	x	F	c	c	1.09 (4)	x	x	X	x	F	c
10/041	N	N	c	c	c	c	1.30 (4)	x	x	F	F	F	9060	F	91340	X	x	x	c
11 /042	c	c	c	c	c	c	c	c	6520	F	c	c	1.04 (4)	F	1.55 (4)	X	x	x	c
12/043	N	N	N	N	c	c	3.04 (4)	x	x	F	c	c	N	N	N	N	N	N	N
13/044	i 390	F	F	F	4390	x	2.88 (4)	9B70	x	x	261	c	1.27 (4)	x	322	1.57 (4)	x	x	F
14/045	N	N	872	F	F	F	F	F	8640	x	F	F	1.12 (4)	x	F	1.92 (4)	x	x	F
15/046	N	N	3920	F	N	N	F	F	9280	x	3330	x	9960	x	F	1.97 (4)	x	X	F
16/047	470	F	8550	F	4440	F	1040	F	8230	x	5370	x	8010	5290	F	2.11 (4)	x	x	"c
17/048	549	F	c	c	2420	F	F	c	c	c	5410	x	C	c	c	C	c	1750	c
10/049	c	c	c	c	C	C	c	c	c	c	c	c	C	c	c	C	c	c	c
19/050	N	N	c	c	N	N	F	1230	F	7290	x	c	C	c	c	C	c	2720	C
20/051	N	N	N	N	N	N	F	350	F	F	c	c	C	c	c	C	c	1360	c
21 /052	312	F	c	c	c	c	c	c	c	c	c	c	C	1 730	F	9210	x"	x	C
22/053	c	c	c	c	c	c	·C	c	c	c	C·	c	C	c	C	C	c	C	c
23/054	c	c	c	c	c	c	c	c	c	c	c	c	C	c	c	C	C	c	c
24/055	N	N	6940	F	N	N	c	654	c	c		x	3.61 (4)	x	x	X	x	x	F
25/056	c	c	c	c	c	c	c	c	c	c	c	c	C	7a50	1.99 (4)	X	x	x	F
26/057	c	c	c	c	c	c	C	c	c	c	c	c	C	4260	F	C	c	c	F
27/058	c	c	c	c	c	c	c	c	c	c	c	c	C	c	c	C	c	c	F
2B/059	c	C	c	c	c	c	C	C	c	C	c	C	C	c	C	C	c	c	c

c: Cloudy; F: Frozen; N: No suitable imagery; O: Open water.

X: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

1.11/(4) indicates an area of 11100 square kilometers.

Table 12. Areas of Nineteen Polynyi in Chukchi and Bering Seas in 1975.

MARCH	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	V	W
01 /060	C	C	c	C.	c	c	c	c	c	c	c	C	C	c	C	C	C	C	c
02/061	c	c	c	c	c	c	c	c	C	c	C	C	c	c	c	c	c	C	c
03/062	c	c	c	c	c	c	c	c	c	c	C	C	C	c	c	C	c	c	c
04/063	N	N	F	2560	F	4200	0280	x	F	c	104	F	C	c	c	c	7570	x	F
05/064	C	c	c	c	F	3410	7290	x	F	c	c	C	3940	c	6504	1020	548	5240	N
06/065	C	C	c	c	c	c	c	c	c	C	c	C	c	c	c	c	c	c	c
07/066	C	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
00/067	N	N	F	3610	N	N	1.41 (4)	x	F	F	'c	c	7300	c	c	c	c	C	3340
09/068	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
10/069	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
1 1 /070	c	C	c	c	c	c	c	c	c	c	C	c "	c	c	c	c	c	c	c
12/071	N	N	c	C	N	N	c	c	c	c	c	c	C	c	c	c	c	C	c
13/072	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14/073	N	N	1410	F	c	c	2.50 (4)	x	x	354	217	610	3220	F	F	c	C	C	2110
15/074	N	N	2310	F	3330	F	1.36 (4)	F	7030	311	2500	x	2950	x	c	C	3980	x	c
16/075	c	c	c	c	c	c	c	c	c	c	c	c	2850	x	c	c	6900	x	C
17/076	N	N	4400	F	N	N	3930	1200	6500	x	5400	x	47io	x	c	c	5400	x	c
18/077	N	N	2950	F	N	N	9590	F	5940	786	5370	x	F	c	F	c	8950	x	c
19/078	2340	F	4340	F	32(30	F	F	F	4600	790	6270	x	2470	825	F	557	6720	x	C
20/079	2770	F	4200	F	5990	x	F	F	5720	1140	7890	x	c	c	c	716	7770	x	c
21/080	4110	F	" 6850	F	4720	F	F	c	c	1000	7720	x	F	N	N	N	N	N	c
22/081	2770	F	6260	F	5770	F ,	F	F	5920	116	7240	F	F	462	F	c	c	c	c
23/082	N	N	8740	F	N	N	c	c	c	c	c	c	c	2100	c	6880	x	x	c
24/083	N	N	6580	F	N	N	c	c	1630	c	c	c	c	c	c	c	c	c	c
25/084	N	N	1.32 (4)	F	N	N	F	F	1 630	F	7140	x	c	c	c	c	c	3B7	c
26/085	C	C	c	c	c	c	c	C	C	c	c	C	C	1100	c	7440	F	F	c
27/086	c	c	c	c	c	c	c	C	C	c	C	c	C	c	c	C	c	C	c
28/087	N	N	c	c	F	1770	2060	c	c	C	c	c	c	c	c	c	754	3760	c
29/088	c	c	c	C	c	c	c	c	C	c	c	c	c	c	c	c	c	c	c
30/089	N	N	c	C	F	2130	F	1 900	c	c	c	c	C	c	C	c	c	4020	c
31/090	N	N	F	484	N	N	F	976	1 570	c	c	c	c	C	C	c	1410	3060	c

c: Cloudy}   F: frozen;   N: No suitable imagery; O: Open water.

x: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

1. 11/(4) indicates an area of 11100 square kilometers.

Table 13. Area of Nineteen Polynyii ● Chukchi and Bering Seas in 1975.

APRIL	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	V	W
01/091	N	N	N	N	c	c	C	c	c	F	N	N	C	C	C	C	C	C	c
02/092	c	C	F	290	F	1600	F	1100	631	F	F	F	F	F	109	1840	x	3990	c
03/093	c	c	c	c	c	c	c	c	974	c	c	c	c	c	c	C	C	3190	c
04/094	c	c	c	c	F	3090	c	c	c	C	C	C	c	c	c	5350	x	x	c
05/095	N	N	F	2220	N	N	F	C	2570	C	C	c	3710	c	c	2.11 (4)	x	x	c
06/096	N	N	1230	x	F	3250	1020	203	2390	C	c	c	3260	c	992	2.18 (4)	x	x	C
07/097	N	N	1240	x	N	N	c	480	F	C	c	c	3090	206	1110	2.81 (4)	x	x	C
08/098	N	N	F	2320	N	N	F	549	F	162	282	F	3860	x	470	2.57 (4)	x	x	C
09/099	N	N	4550	F	N	N	F	F	1180	296	1040	744	3590	x	636	2.82 (4)	x	x	c
10/100	N	N	4690	F	c	c	544	F	1780	887	2650	x	2830	x	c	2.61 (4)	x	x	c
11/101	N	N	c	c	N	N	F	F	1700	692	2090	x	2900	x	c	2.78 (4)	x	"x	c
12/102	c	c	c	c	c	c	c	c	c	c	c	c	F	700	124	2.20 (4)	x	x	C
13/103	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	C	c	c	c
14/104	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	C	c	c	c
15/105	N	N	1950	F	N	N	1010	4390	F	c	190	418	c	1210	F	F	F	F	F
16/106	N	N	N	N	3440	x	F	3880	F	c	c	c	c	660	F	F	F	F	F
17/107	N	N	3450	F	N	N	F	3250	F	F	F	F	c	F	F	F	F	F	F
18/108	N	N	N	N	1510	F	F	2640	F	F	C	c	F	F	F	F	F	F	N
19/109	c	c	c	c	c	c	c	c	c	c	c	c	574	c	488	508	460	F	N
20/110	c	C	c	c	c	c	c	c	c	c	c	c	c	c	c	C	c	c	c
21/111	N	N	1640	F	F	21340	c	5780	F	c	c	c	17150	F	318	684	369	252	c
22/112	600	F	1920	F	F	F	F	3360	181	F	324	230	C	F	222	302	380	F	c
23/113	N	N	3060	F	22150	F	F	5180	x	F	988	211	F	F	F	C	358	C	c
24/114	c	c	N	N	c	c	c	1940	2590	387	1460	x	c	C	c	C	c	c	c
25/115	c	c	7910	F	4500	x	1430	1310	4240	878	3140	x	C	666	C	C	628	F	c
26/116	N	N	1.09 (4)	F	N	N	c	F	6140	x	4090	x	c	931	91	1200	x	F	c
27/117	1510	F	9800	F	4860	F	F	F	5740	x	6640	x	C	c	c	1380	x	F	c
28/118	N	N	8640	F	N	N	F	F	4370	x	7150	x	F	F	F	1080	x	c	c
29/119	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
30/120	N	N	c	c	4790	F	F	F	5920	x	8790	x	F	F	F	F	F	F	F

C: Cloudy; F: Frozen; N: No suitable imagery; O: Open water.

X: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

1.11/(4) indicates an area of 11100 square kilometers.

Table 14. Area of Nineteen Polynyi in the Chukchi and Bering Seas in 1975.

MAY	A	*	D	E	Q	H	I	J	K	L	M	P	Q	R	S	T	u	V	W
01/121	N		0990	F	N	N	1590	c	6390	X	J30	x	F	585	F	c	c	F	
02/122	N	N	1.28 (4)	F	N	N	1450	C	6360	x	9640	x	c	B05	F	c	1060	F	,
03/123	c	c	1.08 (4)	F	c	c	c	F	6650	x		x	c	c	c	F	1400	4s1	C
04/ 124	N	N	c	c	N	N	c	c	6030	X	1.30 (4)	x	c	c	c	c	818	850	c
05/125	C	C	c	c	c	c	c	c	c	c	c	c	c	c	c	c	C	c	C
06/126	N	N	1.90 (4)	F	N	N	F	F	59s0	x	9720	x	c	c	C	c	F	1100	c
07/127	N	N	1.22 (4)	F	376.0	F	F	F	solo	669	6940	x	c	F	F	308	F	922	N
08/ 128	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
09/129	N	N	N	N	N	N	c	c	1.33 (4)	x	x	x	F	F	F	c	97	F "	N
10/130	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
11/131	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12/132	N	N	5.80 (4)	F	N	N	2740	F	1.89 (4)	X	x	X	F	F	916	1.65 (4)	X	x	C
13/133	N	N	N	N	N	N	3440	c	C	C	c	c	c	F	518	1.88 (4)	X	x	N
14/134	N	N	c	c	N	N	c	F	1.90 (4)	x	x	x	F	F	880	3.15 (4)	X	x	C
15/135	N	N	N	N	O	o	C "	F	1.34 (4)	x	x	x	F	F	c	2.11 (4)	X	x	N
16/136	N	N	7.13 (4)	N	O	O	1.13 (4)	F	2.35 (4)	X	x	x	F	688	438	2.53 (4)	X	x	F
17/137	O	o	N	N	O	O	c	F	1.39 (4)	x	x	F	F	863	N	N	N	N	F
18/138	o	O	c	c	O	O	c	c	C	C	c	c	c	725	C	2.20 (4)	x	x	c
19/139	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
20/140	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
21/141	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
22/142	C	c	c	c	c	c	c	c	C	c	c	c	c	692	F	1.74 (4)	X	x	C
23/143	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
24/144	c	C	c	c	c	c	c	c	C	c	c	c	c	C	C	1.60 (4)	X	x	c
25/145	C	c	C	c	c	c	c	c	c	c	c	c	F	F	F	2.31 (4)	x	x	c
26/146	c	C	c	c	c	c	c	c	C	c	c	c	c	C	C	C	C	c	c
27/147	C	C	c	c	c	c	c	c	3.55 (4)	X	x	x	c	681	3.29 (4)	X	X	x	c
28/148	C	C	c	c	c	c	c	c	C	C	c	c	c	C	2.93 (4)	X	X	x	c
29/ 149	c	c	c	c	c	c	c	c	3.49 (4)	x	X	x	c	F	3.33 (4)	X	X	x	c
30/150	C	c	c	c	c	c	c	c	2.54 (4)	x	X	x	c	F	2.38 (4)	X	x	x	c
31/151	C	C	O	O	c	c	c	c	3.38 (4)	x	X	x	c	C	3.04 (4)	X	x	x	c

C: Cloudy; F: Frozen; N: No suitable imagery; O: Open water.

X: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

1. 11/(4) indicates an area of 11100 sqkuare kilometers

Table 15.   Areas of Nineteen Polynyi in Chukchi and Bering Seas in 1975.

JUNE	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	V	W
01/152	0	o	o	0	0	0	0	F	3.00 (4)	x	x	X	F	F	2.74 (4)	X	x	x	C
02/153	o	0	0	0	0	o	o	F	3.89 (4)	X	x	x	F	262	3.71 (4)	x	x	x	C
03/154	0	0	0	0	0	0	0	F	3.15 (4)	x	x	x	F	F	3.21 (4)	x	x	x	C
04/155	0	0	0	0	0	0	0	F	4.55 (4)	x	x	x	374	272	4.20 (4)	x	x	x	C
05/156	o	0	0	0	0	0	0	F	3.72 (4)	x	x	x	218	591	2.97 (4)	x	x	x	c
06/157	0	0	0	o	0	0	0	o	o	0	0	0	346	3.96 (4)	x	x	x	x	C
07/158	0	0	o	0	0	0	0	0	0	0	0	0	c	c	c	C	C	c	C
08/159	0	0	0	o	0	0	0	0	0	0	0	0	356	4.38 (4)	x	x	x	X	C
09/160	0	0	0	0	0	0	0	o	0	0	0	o	302	4.62 (4)	x	x	x	x	c
10/161	0	0	0	0	0	0	0	0	0	0	0	0	366	4.52 (4)	x	x	x	x	C
11/162	0	0	0	0	0	0	0	0	0	0	0	o	c	5.?	x	X	x	x	c
12/163	0	o	0	0	0	0	0	0	0	0	0	0	o	C	c	c	x	x	C
13/164	o	0	0	0	0	0	0	0	0	0	0	0	o	c	c	c	C	C	c
14/165	0	0	0	0	0	0	0	0	0	0	0	0	o	c	c	c	c	c	C
15/166	0	0	0	0	0	0	0	0	0	0	0	0	o	c	c	C	c	C	c
16/167	0	0	0	0	0	0	0	0	0	0	0	0	o	c	c	c	c	C	c
17/168	0	0	0	0	0	0	0	0	0	0	0	0	o	c	c	3.86 (4)	x	x	C
18/169	0	II	0	0	0	0	0	0	0	0	0	0	3	c	C	c	c	C	c
19/170	0	0	0	0	0	0	0	0	0	0	0	o	Q	C	c	c	c	C	C
20/171	0	0	0	0	0	0	0	0	0	0	0	0	o	c	c	c	C	C	C
21/172	0	0	0	0	0	0	0	0	0	0	0	0	o	c	c	C	C	c	C
22/173	0	0	0	0	o	0	0	0	0	0	0	o	o	c	c	C	C	c	c
23/174	0	o	0	0	0	0	0	0	0	0	o	0	o	c	C	C	c	C	c
24/175	0	0	0	o	0	0	0	0	0	0	0	0	o	c	c	c	c	C	c
25/176	0	0	0	o	c1	0	0	0	0	0	0	0	o	C	c	c	c	C	C
26/177	o	0	0	0	o	0	0	0	0	o	0	0	0	C	c	c	C	C	c
27/178	0	0	o	o	0	0	0	0	0	0	o	0	o	F	c	c	c	c	c
28/179	c	c	C	C	C	c	c	c	c	c	c	c	c	F	c	1.26 (4)	x	x	c
29/180	c1	0	o	o	o	0	0	0	o	0	o	0	0	c	c	c	c	C	C
30/181	0	0	0	0	0	0	0	0	0	0	0	0	o	c	c	c	C	C	C

C: Cloudy;   F: Frozen;   N: No suitable imagery;   O: Open water.

X: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

Table 16.   Areas of Nineteen Polynyi（） Chukchi and Bering Seas in 1976.

FEBRUARY	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	W
01/032	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
02/033	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
03/034	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
04/035	N	N	N	N	N	N	N	N	N	N'	N	N	N	N	N	N	N	N
05/036	451	F	1170	F	C	c	N	c	c	c	2530	X	F	1490	C	C	C	C	F
06/037	648	F	2570	F	1380	F	F	F	3580	1080	130	C	F	2160	F	C	F	F	F
07/038	2420	F	F	F	1230	F	F	F	4310	2060	3050	c	F	1180	F	C	c	C	F
08/039	i60	F	F	F	F	F	F	F	4070	F	886	X	c	1210	c	C	F	F	F
09/040	1260	F	1680	F	c	c	F	F	4520	X	8310	x	F	3730	F	F	F	F	F
10/041	550	F	2010	F	c	c	F	F	584	F	653	F	F	1970	F	C	c	c	c
i1 /042	c	c	c	c	c	c	F	F	9s	2010	1.28(4)	x	F	2010	F	C	c	c	F
12/043	c	c	1947	F	c	c	F	F	4B20	X	i.38(4)	x	F	4000	785	F	F	c	F
13/044	c	c	829	F	c	c	F	F	325	273	F	F	F	1720	C	C	c	c	C
14/045	c	c	1330	F	c	c	F	F	1890	196	636	245	F	c	c	F	F	F	F
1 5/046	276	F	230	F	461	F	F	F	483	206	214	F	c	5960	F	F	F	F	F
16/047	648	F	740	F	928	F	c	F	553	c	c	c	c	c	c	F	F	F	F
17/048	560	F	c	c	404	c	c	F	475	F	F	F	c	c	F	F	F	F	F
18/049	c	c	c	c	c	c	c	F	4570	X	F	1330	F	5280	F	F	F	F	F
19/050	416	F	810	F	429	c	c	F	1513	F,	96	F	c	c	C	F	1020	F	F
20/051	c	c	140	c	c	c	1640	F	6060	xl	361	1370	F	2770	F	F	1320	F	F
21/052	c	c	c	c	c	c	c	F	271	F	146	9s0	F	2460	F	F	1 490	F	c
22/053	275	F	1250	F	972	F	345	F	1230	318	562	x	F	1450	F	F	1530	F	F
23/054	388	F	91	F	1140	F	c	F	i240	F'	154	1910	C	c	c	c	C	c	c
24/055	264	F	486	F	1 100	c	c	c	c	c	455	c	F	F	F	c	c	C	c
25/056	324	F	88	"F	820	F	F	F	654	F	532	1310	F	1410	F	F	F	F	c
26/057	F	F	2200	F	N	N	362	F	741	263	508	602	652	c	c	c	c	c	1 220
27/058	2313	F	134	F	2670	F	F	F	F	F	F	F	927	F	667	c	c	c	5380
20/059	c	c	F	F	c	c	c	F	23	F	F	F	770	c	c	c	c	c	942
2$'/060	c	c	c	c	c	c	F	F	426	C	c	c	670	F	720	F	c	c	942

C: Cloudy;   F: Frozen;   N: No suitable imagery; Q: Open water.

x: The number to the left of an X or many X's is the total area in square   kilometers of two or more fused polynyi.

1. 11/(4) indicates an area of 11100 square kilometers.

Table 17. Areas of Nineteen Polynyi ●e Chukchi and Bering Seas in 1976.

MARCH	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	V	W
01/061	c	c	c	c	c	c	537	c	531	c	c	c	c	c	828	c	c	c	924
02/062	c	c	c	c	c	c	c	c	c	c	c	c	c	F	980	F	F	F	3740
03/063	c	854	c	c	c	1760	1020	1650	c	c	c	c	c	c	c	c	c	c	c
04/064	c	1140	c	c	c	2370	c	2150	c	c	c	c	c	c	c	c	c	c	c
05/045	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
06/066	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
07/067	c	c	c	c	c	3610	c	3550	c	c	c	c	2130	c	562	326	c	c	c
08/068	c	c	c	c	c	4830	406	6060	c	c	c	c	1480	c	610	c	c	2070	c
09/069	c	1890	c	4640	c	5970	15940	x	c	c	c	c	1240	F	1080	1470	F	F	c
10/070	c	c	c	4170	c	6150	570	6030	c	c	c	c	3030	c	c	1050	c	c	1840
11/071	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
12/072	c	c	c	c	c	c	c	c	c	c	c	c.	c	c	c	c	c	c	c
13/073	c	1200	c	3750	c	2860	306	4440	c	c	c	F	c	369	c	c	1000	1.12 (4)	c
14/074	353	F	2380	F	484	F	F	F	220	c	530	1180	c	2570	c	742	c	c	c
i 5/075	1600	F	7720	F	1780	F	F	F	1640	154	3780	X	c	C	c	800	c	c	F
16/076	1520	F	8790	F	2630	F	F	F	2160	1780	3950	c"	C	2830	c	c	c	c	c
17/077	2360	F	1.02 (4)	F	3900	F	F	F	6080	x	1.02 (4)	X	F	4460	F	F	c	c	c
18/078	3270	F	1.38 (4)	F	6380	F	1330	F	7440	x	1.08 (4)	c	F	3200	F	F	F	F	c
19/079	3390	F	c	c	5780	F	F	F	6370	x	c	c	c	c	c	c	c	938	c
20/080	c	c	1.69 (4)	c	N	N	1170	c	c	c	896	X	c	362	178	c	280	2000	c
21/081	3620	F	2.02 (4)	F	6050	F	F	c	c	c	1.07 (4)	X	c	640	168	F	1710	1670	c
22/062	2960	F	1.99 (4)	c	c	c	c	c	c	c	4800	X	c	4780	167	F	1680	1290	c
23/083	3360	c	c	c	2370	c	c	c	c	c	c	c	c	1880	149	F	1260	F	F
24/084	576	c	c	c	2470	c	c	c	c	c	c	c	c	1100	F	F	F	F	c
25/085	268	c	c	c	840	c	F	F	2250	F	4100	X	F	5120	F	F	F	F	F
26/086	850	F	1230	F	F	516	F	F	672	F	4930	X	F	5240	F	F	F	F	F
27/007	421	F	1.49 (4)	F	1700	F	F	F	1870	F	662	F	F	4490	134	F	F	F	c
28/088	c	c	c	c	1040	F	F	F	1560	F	4920	x	F	5450	F	F	F	F	F
29/089	236	F	F	381	2360	c	c	F	1690	c	F	148	F	4660	F	F	F	F	F
30/090	c	c	c	529	c	c	C	F	F	F	F	F	F	5320	F	F	F	F	F
31/091	c	c	3270	c	c	c	746	F	1220	368	F	F	F	.4790	F	F	F	F	F

C: Cloudy; F: Frozen; N: No suitable imagery; O: Open water.

X: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

1.11/(4) indicates an area of 11100 square kilometers.

Table 18. Areas of Nineteen Polynyi the Chukchi and Bering Seas in 1976.

APRIL	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U	V	W
01/092	C	C	910	C	C	u	C	C	2100	F	1140	X	C	5100	C	C	C	C	F
02/093	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
03/094	C	C	C	C	C	u	902	C	2300	C	1100	C	C	C	C	C	C	C	C
04/095	N	N	N	N	N	Z	C	C	148	C	C	C	C	C	C	C	C	C	C
05/096	532	C	3430	C	1170	u	C	C	C	C	C	C	C	C	C	C	C	C	C
06/097	C	C	F	F	1430	u	C	F	1480	F	F	F	F	F	F	F	F	F	F
07/098	C	C	522	C	C	u	C	C	C	C	C	C	C	C	82	214	C	C	C
08/099	C	C	1230	C	C	u	670	C	1540	407	660	X	C	F	F	F	F	F	F
09/100	C	C	C	C	C	u	350	F	2970	X	C	C	C	F	C	F	F	C	C
10/101	1090	C	C	C	C	C	1600	C	C	C	C	C	C	F	F	F	F	F	C
11/102	C	C	C	C	C	u	C	C	2120	C	C	C	C	C	C	C	C	C	C
12/103	1060	C	C	2440	772	X	C	3490	X	F	C	C	C	C	C	C	C	F	C
13/104	99	F	779	F	271	F	F	192	478	F	C	C	C	C	C	C	C	C	F
14/105	F	F	F	F	292	F	F	358	269	F	C	C	F	C	F	F	F	F	F
15/106	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	F
16/107	C	C	2640	C	C	C	980	F	1790	608	222	F	C	F	F	F	F	F	F
17/108	2030	F	5180	C	C	C	2430	F	3350	X	693	X	F	F	F	F	F	F	F
18/109	1940	F	8320	F	1060	F	3260	F	4260	X	1277	X	F	404	60	F	245	F	F
19/110	2560	F	1,20 (4)	F	1720	F	3550	F	5590	X	2560	X	F	442	124	F	302	F	F
20/111	2180	F	8020	F	1470	F	C	F	2600	IALL	914	1420	F	344	154	F	456	F	u
21/112	1410	F	6830	F	2140	F	1710	F	3030	F	960	1160	C	232	C	C	C	C	C
22/113	1780	F	5500	F	2580	F	3590	F	2920	F	988	688	F	222	129	F	C	C	F
23/114	752	F	6550	F	5190	F	C	F	1440	F	765	1100	F	187	F	F	C	C	F
24/115	625	F	7530	F	4730	F	C	F	2260	F	1470	322	F	265	C	C	C	C	F
25/116	606	C	8960	C	7580	C	C	C	3190	C	C	C	C	C	C	C	C	C	C
26/117	N	N	C	u	C	C	F	F	2380	F	F.	C	F	C	F	C	C	C	C
27/118	95	C	C	C	9190	F	F	F	3170	F	204	F	F	F	C	C	C	F	F
28/119	C	C	6790	u	7160	F	C	F	2740	F	190	F	F	C	275	283	F	C	C
29/120	C	C	C	u	C	C	C	C	2940	u	C	C	327	F	593	421	296	1380	C
30/121	C	C	C	u	5070	1070	C	C	C	C	C	C	C	C	132	C	C	C	C

C: Cloudy.   F: Frozen.   N: No suitable imagery.   O: Open water.

X: The number to the left of an x or many X's is the total area in square kilometers of two or more fused polynyi

1.11/(4) indicates an area of 11 0 square kilometers.

Table 19.   Areas of Nineteen Polynyi ⬤ Chukchi and Bering Seas in 1976.

MAY	A	B	D	E	G	H	I	J	R	L	M	P	Q	R	s	T	U	W
01/122	F	180	F	6000	50B0	1B30	3540	F	2400	F	F	F	F	F	560	533	F	436	F
02/123	c	c	742	c	c	C	3820	F	2940	F	F	F	111	258	833	1750	x	764	C
03/ i 24	c	C	c	c	c	c	c	C	c	c	C	c	C	150	1020	3390	x	1660	C
04/125	c	c	C	c	c	c	c	F	3310	F	F	F	c	c	c	F	c	C	C
05/126	c	C	c	c	c	c	c	c	c	c	c	c	C	c	c	c	c	C	C
06/127	c	c	c	C	c	c	c	F	4350	F	F	F	c	c	C	c	C	c	c
07/12(3	c	C	c	c	c	c	c	c	c	F	F	115	c	312	c	3300	x	1040	c
08/129	c	C	c	c	c	c	c	c	c	c	C	3B2	C	374	346	4430	x	7B7	C
09/130	c	c	3590	C	c	c	F	F	4B60	C	307	x	c	405	194	4370	x	444	c
10/131	4B2	C	c	c	N	N	F	F	7380	x	2350	X	F	1260	214	4290	x	20 1	F
11/132	c	C	c	c	c	c	c	c	c	c	1670	1420	c	2320	130	4580	x	F	c
12/133	c	C	c	c	c	c	c	c	c	c	c	c	c	1 3 2	1790	4950	x	F	c
13/134	c	C	c	c	c	c	c	F	4440	F	3840	x	F	1920	140	5350	x	F	c
14/135	c	C	c	c	c	c	c	c	c	c	4270	X	C	F	95	4410	x	F	c
15/136	c	C	c	c	c	c	c	c	4400	c	C	c	c	c	c	3320	x	F	c
16/137	c	C	c	c	c	c	c	c	c	c	c	c	c	c	c	6080	x	193	c
17/138	c	C	c	c	c	c	c	c	2930	c	c	c	c	c	c	1.04 (4)	x	518	c
18/139	c	c	c	c	c	c	c	c	c	c	c	c	F	79	634	H91O	x	C	C
19/140	c	c	c	c	c	16130	7720	F	5150	x	562	1100	F	888	188	1.08 (4)	x	F	F
20/141	F	2100	8.18 (4)	F	cl	F	i .26 (4)	x	8870	x	1970	1790	F	1110	F	9260	x	F	F
21/142	F	2210	9 17 (4)	F	o	F	6970	F	7B00	x	2430	2160	F	1240	8860	x	x	F	F
22/143	c	c	7.64 (4)	F	0	c	1. 10 (4)	x	9600	x	4270	X	F	924	8470	x	x	F	F
23/144	c	c	c	c	0	c	c	c	9710	x	7260	X	N	N	N	N	N	N	N
24/145	c	c	c	c	0	1.84 (4)	x	x	2.06 (4)	x	X	X	c	817	c	1.08 (4)	x	x	C
25/ 146	c	c	c	c	c	c	c	c	c	c	c	c	c	C	C	c	c	c	c
26/147	c	c	c	c	c	c	c	c	c	c	C	c	c	c	C	C	c	C	c
27/14B	c	c	c	c	c	c	c	C	2.57 (4)	x	x	x	C	c	c	5650	x	C	F
2B/ 149	c	c	c	c	0	0	c	c	c	c	C	C	c	c	C	4B0O	x	c	C
29/150	c	c	c	c	0	o	c	c	2.72 (4)	X	X	X	c	C	c	6080	x	C	c
30/151	c	c	c	C	0	0	c	c	c	C	C	C	C	C	C	C	C	C	C
31/152	C	c	c	c	0	0	c	c	C	C	C	C	C	C	C	C	C	C	C

C: Cloudy;   F: Frozen;   N: No suitable imagery;   O: Open water.

X: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

1.11/(4) indicates an area of 11100 square kilometers.

Table 20.   Areas of Nineteen Polynyi ● e Chukchi and Bering Seas in 1976.

JUNE	A	B	D	E	G	H	I	J	K	L	M	P	Q	R	S	T	U		W
01/153	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		N
02/154	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		N
03/155	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		N
04/154!	C	C	C	c	C	C	c	c	1.49 (4)	X	X	X	F	F	F	7360	X	F	C
05/157	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		N
06/158	C	C	c	C	c	C	c	c	C	c	c	c	C	c	C	c	C	4100	C
07/159	C	C	C	c	C	C	c	c	C	c	c	c	C	F	F	4460	X	F	C
08/160	C	C	C	c	c	C	C	c	C	c	c	c	C	F	C	c	C	F	C
09/161	O	O	O	o	O	O	c	c	1.08 (4)	X	X	X	F	F	F	7840	X	860	F
10/162	O	c1	O	o	O	O	o	N	N	N	N	N	F	79	211	7300	X	683	F
11/163	O	O	O	o	O	O	O	F	1.42 (4)	X	X	X	F	64	F	8260	X	146	F
12/164	D	O	O	o	o	O	O	F	1.75 (4)	X	X	X	F	C	F	7200	X	c	F
13/165	O	O	O	o	O	O	O	F	1.64 (4)	X	X	X	C	c	C	6000	X	105	
14/166	O	O	O	o	O	O	O	F	1.54 (4)	X	X	X	F	181	364	6930	X	252	
15/167	O	O	O	o	O	O	O	c	C	C	C	C	F	845	6940	x	X	F	
16/168	O	o	O	o	O	O	O	c	C	C	C	C	F	1390	1.02 (4)	x	X	93	
17/169	O	O	O	o	O	O	O	c	C	C	C	C	F	1200	1.42 (4)	x	X	686	
18/170	O	O	o	o	O	O	O	c	C	C	C	C	c	c	1.34 (4)	x	X	1200	
19/171	O	O	O	o	O	O	O	c	C	C	C	C	C	c	C	c	C	C	
20/172	O	O	O	O	O	O	O	C	C	c	C	C	C	C	c	C	c	c	
21/173	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
22/174	o	O	O	o	O	O	o	c	C	C	C	C	C	c	C	C	c	c	
23/175	O	O	O	o	O	O	O	c	C	C	C	C	c	c	C	c	C	c	
24/176	O	O	O	O	O	O	O	C	c	C	C	C	C	C	C	C	c	c.	
25/177	O	O	O	o	O	O	O	c	C	C	C	C	c	F	353	4500	X	324	
26/178	O	O	O	o	O	O	O	o	O	O	O	O	c	c	C	c	C	c	
27/179	O	O	O	o	O	O	O	O	O	O	o	o	c	c	C	c	C	F	
28/180	O	O	O	o	Q	O	O	O	O	O	O	O	c	556	C	3220	140	F	
29/181	O	O	O	o	o	O	O	O	O	O	O	O	c	4850	X	4530	576	F	
30/i 82	O	O	O	o	O	O	O	O	O	O	O	O	c	c	C	C	c	c	

C: Cloudy;   F: Frozen;   N: No suitable imagery;   O: Open water.

X: The number to the left of an X or many X's is the total area in square kilometers of two or more fused polynyi.

1. 11/(4) indicates an area of 11100 square kilometers

Table 21. Areas of Nineteen Polynyi in the Chukchi and Bering Seas in 1976.

JULY	A	B	D	E	G	H	I	J	K	L	M	P	G	R	S	T	U	V	W
01/183	O	O	O	O	O	O	O	0	O	cl	0	0	O	C	C	C	C	C	C
02/184	O	O	O	u	O	O	O	O	0	cl	O	0	O	u	C	u	C	C	C
03/185	O	0	O	0	0	0	0	O	0	0	O	0	0	C	C	C	C	C	C
04/186	O	0	O	0	0	0	0	O	0	0	O	0	0	C	C	C	C	C	u
05/187	O	0	O	O	O	0	0	0	0	0	O	cl	0	C	C	C	C	v	u
06/188	O	O	O	O	0	0	0	0	O	0	0	0	O	C	C	C	C	u	u
07/189	O	O	O	0	O	O	O	O	O	0	0	O	O	C	C	C	C	C	
08/190	O	O	O	O	O	0	O	0	O	0	O	O	O	O	590	4490	X	F	
09/191	O	O	O	O	O	0	O	O	O	O	0	O	O	O	O	6860	X	491	
10/192	O	O	O	O	O	0	O	O	O	O	O	O	O	O	O	9110	x	1620	
11/193	O	O	O	O	0	O	O	O	O	O	O	O	O	O	O	1.15(4)	X	3170	
12/194	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	1.46(4)	X	1680	
13/195	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	C	u	C	
14/196	O	0	O	O	0	0	O	O	0	0	O	a	cl	0	0	1.09(4)	X	755	
15/197	0	O	O	0	0	0	0	0	0	a	0	0	O	0	O	1.37(4)	2560	463	
16/198	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	1.22(4)	X	3100	
17/199	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	C	4060	X	
18/200	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	C	C	438	
19/201	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	C	C	c	
20/202	O	O	O	O	0	0	0	0	0	0	0	0	O	O	0	C	C	c	
21/203	O	O	O	0	O	O	0	O	O	O	O	O	O	0	O	C	u	u	
22/204	O	O	O	O	O	O	0	0	O	O	0	O	O	O	O	O	O	F	
23/205	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	F	
24/206	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	F	
25/207	O	O	O	O	O	O	O	O	O	O	O	O	0	O	O	O	O	F	
26/208	O	O	O	O	O	O	O	O	O	O	O	O	O	0	O	O	O	C	
27/209	O	O	O	O	O	O	O	O	O	O	O	O	0	0	O	O	O	C	
28/210	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	C	
29/211	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	C	
30/212	0	O	O	O	O	O	O	0	O	0	O	0	0	0	0	O	O	u	

C: Cloudy; F: Frozen; N: No suitable imagery; O: Open water.

X: The number to the left of an X or X's is the total area in square kilometers of two or more fused polynyi

1.11/(4) indicates an area of 11100 square kilometers

REFERENCES

Carleton, A. M. (1980) Polynya Development in the Cape Thompson-Pt. Hope Region, <u>Arctic</u> <u>and</u> <u>Alpine</u> <u>Research</u>, Vol. 12, No. 2, pp. 205-214.

⬤, B., Moore, H. and A. Gregory (1979) Monitoring and Mapping Sea Ice Breakup amd Freezeup of Arctic Alaska from Sattelite Data, <u>Arctic</u> <u>and</u> <u>Alpine</u> <u>Research</u>, Vol. 11, No. 2, pp. 229-242.

Dey, B. (1980) Applications of Satellite Thermal IR Images for Monitoring North Water during Periods of Polar Darkness, <u>Journal</u> <u>of</u> <u>Glaciology</u>, Vol 25, No. 83, pp. 425-438.

Dickson, R. R. (1975) Weather and Circulation of February 1975, <u>Monthly</u> <u>Weather</u> <u>Review</u>, Vol. 103, No. 5, pp. 456-460.

Dickson, R. R. (1975) Weather and Circulation of May 1975, <u>Monthly</u> <u>Weather</u> <u>Review</u>, Vol. 103, No. 8, pp. 747-752.

McNutt, L. (1981) Remote Sensing Analysis of Ice Growth and ⬤tribution in the Eastern Bering Sea; <u>The</u> <u>Eastern</u> <u>Bering</u> <u>Sea</u> <u>Shelf:</u> <u>eanography</u> <u>and</u> <u>Resources</u>, Vol.1 (1981), D. W. Hood and J. A. Calder, eds., Office of Marine Pollution, U. . S. National Oceanographic and Atmospheric Administration? Washington, D. C., pp. 141-165.

Schumacher, J. D., K. Aagaard, C. H. Pease, and R. B. Tripp (1983) Effects of Shelf Polynya on Flow and Water Properties in the Northern Bering Sea, <u>Journal</u> <u>of</u> <u>Geophysical</u> <u>Research</u>, Vol. 88, No. C5, pp. 2723-2732.

Stirling, I. and H. Cleator (1981) Polynyas in the Canadian Arctic, Occasional Paper No. 45., Canadian Wildlife Service

Stringer, W. J. (1981) Nearshore Ice Characteristics in the Eastern Bering Sea; <u>The</u> <u>Eastern</u> <u>Bering</u> <u>Sea</u> <u>Shelf:</u> <u>Oceanography</u> <u>and</u> <u>Resources</u>, Vol.1 (1981), D. W. Hood and J. A. Calder, eds., Office of Marine ⬤lution, U. S. National Oceanographic and Atmospheric ⬤ministration, Washington D. C., pp. 167-187.

Stringer, W. J. (1982) Width and Persistence of the Chukchi Polynya, Geophysical Institute, University of Alaska-Fairbanks, NOAA-OCS Contribution No. 81-RAC00147.

Stringer, W. J. (1985) Ice Movement in the Eastern Beaufort Sea related to widening of the Cape Bathhurst Polynya,

Stringer, W. J. , Barnett, D. G. and R. H. Godin (1984) Handbook for Sea Ice Analysis and Forcasting, Geophysical Institute, University Alaska- FAirbanks, Contract No. N00228-81-C-H553.

Stringer, W.J. and J. E. Groves (1985) Statistical Description of the Summertime Ice Edge in the Chukchi Sea, Geophysical Institute, University of Alaska-Fairbanks, U. S. Department of Energy Contract No. DE-AC21-83MC20037, November 8 , 1985.

Smith, M. and B. Rigby (1981) Distribution of Polynya in the Canadian Arctic; Polynyas in the Canadian Arctic, Stirling I and H. Cleator, eds., Occasional Paper No. 45., Canadian Wildlife Service, pp. 7-27 .

Taubensee, R. E. (1975) Weather and Circulation of March 1975, Monthly Weather Review, Vol. 103, No. 6, pp. 562-566.

bensee, R. E. (1975) Weather and Circulation of June 1975, Weather Review, vol. 103, No. 9, pp. 839-844.

*

Wagner, J. A. (1975) Weather and Circulation of January 1975, Monthly West'hec Review, Vol . 103, No. 4, pp. 360-367.

Wagner, J. A. (1975) Weather and Circulation of April 1975, Monthly Weather Review, Vol. 103, No. 7, pp. 657-664.